

Borough of



Southport.

Meteorological Department.

THE FERNLEY OBSERVATORY,
SOUTHPORT.

REPORT

AND

RESULTS OF OBSERVATIONS
FOR
THE YEAR 1898.

BY

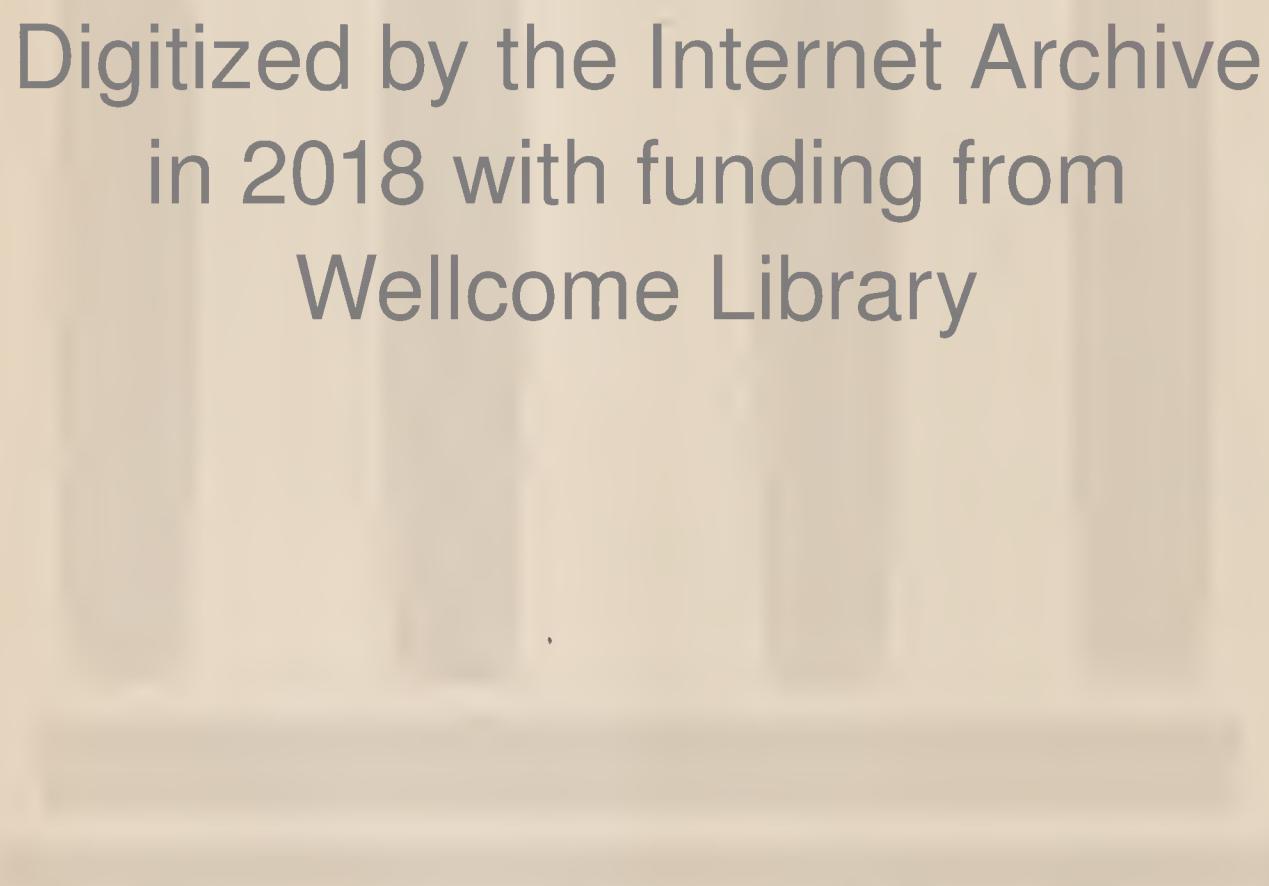
JOSEPH BAXENDELL, F. R. Met. S.,

Meteorologist to the Southport Corporation.

SOUTHPORT :

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TO THE CHAIRMAN AND MEMBERS OF THE PARKS AND CEMETERY
COMMITTEE OF THE SOUTHPORT TOWN COUNCIL.

GENTLEMEN,

I have the honour of submitting to you (a) my Report relative to the administration of the Meteorological Department of the Borough of Southport in the year 1898, and (b) the principal Results of the Observations made under my supervision during that year.

Personnel.—In addition to myself, the following individuals were employed by the Department during the year, in the several capacities indicated:—

F. Lees Halliwell	Chief Assistant.
James Peet	Observer at Hesketh Park.
James France	Foreman Skilled Workman.
A. E. Arrowsmith	Auxiliary Attendant.

Harold C. Heath.....	Sea Observer.
James Howard	Observer at Downholland Sub-Station.
Miss Graham	Observer at Ashurst's Beacon Sub-Station.

The instruments at the Marshside Anemograph, &c., Station were attended to principally by the Chief Assistant.

Additional workmen of various classes were temporarily engaged, when necessary, by the Foreman Skilled Workman, subject to my approval.

Acquisitions.—At the Annual Meeting of the Trustees of the Fernley Residuary Trust Fund, held in January, 1898, a supplementary grant was most kindly voted to the Fernley Observatory for the purchase of Self-Recording Wind Direction Apparatus, and for other purposes. A special vote of thanks to the Trustees for this additional act of generosity was passed by the Town Council on February 8th.

A suitable form of Wind Direction Recorder was designed early in the year, and was constructed during the spring by Mr. J. J. Hicks, of London, and the staff of this Department, being mounted in May at the Marshside Fog Bell Station in close proximity to the Dines Recording Pressure Tube Anemometer erected there in the previous summer, thus completing the originally contemplated Anemographic equipment of that Station. The new Direction Apparatus—elsewhere in this Report referred to as the “Recording Anemoscope”—possesses some features which are not common to any of the older instruments of that class, and as the records obtained by its use have been entirely satisfactory, it will probably be described in detail in a communication to the Royal Meteorological Society.

A Richard Thermograph, and a Richard Hair Hygrograph, were procured from Mr. L. P. Casella, of London, in the early autumn, and were brought into use in the Fernley Louvred-Structure at the Hesketh Park Observatory on September 16th. A spare clock and drum, available alike for either of these instruments or for the Richard Aneroidograph, was acquired at the same time.

A Sensitive (Bifurcated bulb) Minimum Thermometer, by Casella, was mounted by the side of the ordinary Minimum Thermometer in the Fernley Louvred-Structure on October 20th.

At the suggestion of Mr. G. J. Symons, F.R.S., &c., and with the kind assistance of both that gentleman and Mr. G. H. Hill, M. Inst. C. E., of Manchester and London, an Evaporation Tank, six feet square, and two feet in depth (with a Hook Gauge and still-water pond), was purchased in the autumn. For the purpose of securing a perfectly open exposure, it was considered desirable for the tank to be used at our Downholland Sub-Station, and, the necessary permission having been kindly given, a circular plot of land, 25 feet in diameter, was accordingly selected on Barton Moss, Downholland, and enclosed by a strong iron fence, the Tank being suitably sunk in the ground at the end of October, and a 5-in. copper Snowdon-pattern Raingauge, by Casella, being planted close to one side of the Tank.

A Sensitive (Cylinder-Jacket bulb) Terrestrial Radiation Minimum Thermometer, by Hicks, was brought into use at the Downholland Station on October 29th.

An additional Symons-pattern Earth Thermometer, constructed by Messrs. Negretti and Zambra to my specifications, on their slow-acting principle, and having a specially open scale and fixed zero, was placed in the hill green at the Hesketh Park Observatory on December 16th, for observations of the temperature of the ground at the depth of twenty feet below the surface.

Improvements and Repairs.—The Robinson Anemometer at the Hesketh Park Observatory was taken to pieces, repaired, and thoroughly cleaned on February 10th.

The Sight Indicator of the Dines Pressure Tube Anemometer at Hesketh Park was replaced on December 1st by a new one, constructed by Mr. R. W. Munro, of London, consisting of a single tube only (viz., the "open" one), and provided both with spirit reservoirs, as suggested by Mr. Dines, and metal unions in supersession of the india-rubber connections previously employed.

A considerable number of minor, but in several cases important, improvements and repairs to a number of the instruments and structures at the Park Observatory and the Marshside Station were carefully carried out during the year by the Chief Assistant and Foreman Skilled Workman.

Painting.—The Fernley Structure, Stevenson Screen, and other articles (including ironwork) were repainted in April.

The River Level Gauge at the Downholland Sub-Station was examined and repainted in June ; and the enclosure at the Ashurst's Beacon Sub-Station in September.

The Tide Gauge at the Pierhead Sub-Station was cleaned and repainted in October.

Storm Signals.—The late Pier Manager, Mr. H. J. Duddell, again kindly attended to the Cone Storm Signals on the Promenade, in accordance with the telegraphic despatches received from the Meteorological Office, London. The Cone apparatus was damaged at various times, but was repaired in a substantial manner.

A popular article, describing these Signals and their meanings, was prepared for and published in the principal local papers in the autumn.

Equipment.—The following Instruments were in use at the Observatory and Sub-Stations on December 31st, 1898 :—

At Hesketh Park :—

1. Fortin Barometer, by Negretti and Zambra.
2. Kew pattern Station-Barometer, by Negretti and Zambra.
3. Aneroidograph, by Richard Frères.
4. Large Fernley Louvred-Structure, by Dancer.
5. Dry and Wet bulb Hygrometer, by Hicks, mounted in (4).
6. Maximum Thermometer, by Hicks, mounted in (4).
7. Minimum Thermometer, by Casella, mounted in (4). .
8. *Sensitive* Minimum Thermometer, bifurcated bulb, by Casella, mounted in (4).
9. Thermograph, by Richard Frères.
10. Hair Hygograph, by Richard Frères.
11. Stevenson Screen (Royal Meteorological Society's pattern), by Jenkin.
12. Dry and Wet bulb Hygrometer, by Pastorelli, mounted in (11).
13. Maximum Thermometer, by Hicks, mounted in (11).
14. Minimum Thermometer, by Hicks, mounted in (11).
15. Solar Radiation Maximum Thermometer, black-glass bulb in open air, by Hicks.
16. Solar Radiation Maximum Thermometer, blackened bulb *in vacuo*, by Negretti and Zambra.
17. Solar Radiation Maximum Thermometer, bright bulb *in vacuo*, by Negretti and Zambra.
18. Terrestrial Radiation Minimum Thermometer, spherical bulb, by Hicks.
19. Terrestrial Radiation *Sensitive* Minimum Thermometer, Cylinder-Jacket bulb, by Hicks.
20. Earth Thermometer (Symons' pattern), for one foot below the surface, by Casella.
21. Earth Thermometer (Symons' pattern), for four feet below the surface, by Negretti and Zambra.
22. Earth Thermometer (Symons' pattern), for ten feet below the surface, by Hicks.
23. Earth Thermometer (Symons' pattern), for twenty feet below the surface, by Negretti and Zambra.
24. Lake Thermometer, by Casella.
25. Public Standard Thermometer, with bulb in a louvred screen, by Hicks.
26. 8-in. Raingauge, of copper (Meteorological Office pattern), by Casella.
27. 5-in. Raingauge, of copper (Snowdon pattern), (read weekly and monthly), by Hicks.

- 28. Self-Recording Raingauge, by Casella and Baxendell.
- 29. Wind Vane and Dial, by Dancer.
- 30. Dines Sight-Indicating Pressure Tube Anemometer, by Munro.
- 31. Robinson Anemometer, by Dancer.
- 32. Campbell-Stokes Sunshine Recorder (Meteorological Office pattern), by Negretti and Zambra.
- 33. Jordan Sunshine Recorder (Twin-Chamber pattern), by Negretti and Zambra.
- 34. Evaporation Gauge, by Casella, in a Stevenson Screen, by Hicks.
- 35. Ozone Test Paper and Scale (Moffat's), by Negretti and Zambra, placed in (4).
- 36. Subsoil Water Level Gauge, by Miles and France.
- 37. Dew Board, by Miles and France.

At the Marshside Fog Bell :—

- 38. Dines Self-Recording Pressure Tube Anemometer (large size), by Munro.
- 39. Baxendell Self-Recording Anemoscope, by Hicks.

At the Pierhead :—

- 40. Sea Thermometer, by Hicks.

At Birkdale :—

- 41. 5-in. Raingauge, of copper (Snowdon pattern), by Casella.
- 42. Subsoil Water Level Gauge, by Miles and France.

At Downholland :—

- 43. Evaporation Tank, by Cooper, with a Hook Gauge, by Stanley.
- 44. 5-in. Raingauge, of copper (Snowdon pattern), by Casella.
- 45. River Level Gauge, by Miles and France.
- 46. Terrestrial Radiation Sensitive Minimum Thermometer, Cylinder-Jacket bulb, by Hicks.

At Ashurst's Beacon :—

- 47. 8-in. Raingauge, by Casella.

- At the Meteorologist's Residence :—

- 48. Comparative Standard-of-reference Thermometer, by Negretti and Zambra ; also, in store, Duplicates of all instruments and accessories in use at the Observatory or Sub-Stations consisting wholly or partly of glass.

Official Inspection.—On July 19th, the Observatory and the Marshside Station in general, and the Second-Order instruments in particular, were officially inspected by Mr. William Marriott, F. R. Met. S., on behalf of the Royal Meteorological Society. The Report of that gentleman has not yet been published, but before leaving Southport he was good enough to express himself as being fully satisfied with the condition of the various instruments, and much pleased with the Marshside Station, which latter he had not previously seen.

Returns.—Regular Second-Order Returns were supplied to the Royal Meteorological Society throughout the year, and the results continue to appear in the *Meteorological Record*.

Sunshine Returns were sent to the Meteorological Office both daily and weekly, for the corresponding official *Weather Reports*, the publications and matter mentioned in my Report for the year 1896 being kindly furnished to us in exchange.

The usual information was transmitted monthly, and after the close of the year, to the Editors of the *Meteorological Magazine*, and of *British Rainfall*, respectively; and Sunshine Results were despatched monthly to the Leeds Philosophical and Literary Society, for publication, with returns from several other places, in the *Leeds Mercury* and the *Yorkshire Post*.

Reports.—The customary local Weekly and Monthly Statistical Reports, and the Quarterly Comparative Reports, all of which were sufficiently described in my Annual Report for 1895, were prepared for and published in the *Southport Guardian*, reprints being obtained and distributed as hitherto. The Monthly and Quarterly Reports were also supplied to the *Southport Visiter*, and were duly inserted both in that paper and in the *Waterloo and Crosby Herald*. They also appeared in the *Formby Times*. From the middle of June, abbreviated Weekly Reports were furnished to and appeared in the *Southport Visiter*.

In accordance (in both cases) with your instructions, the Quarterly Climatic Reports were printed on the Minutes, and (through the kind co-operation of the several Editors) were published in the *Liverpool Daily Post*, *Manchester Courier*, *Manchester City News*, *Bradford Observer*, *Leeds Mercury*, *Southport Standard*, &c.

Descriptive Notes on the Months of 1898, have, since the close of the year, been published in the *Southport Visiter* and in the *Southport Guardian*.

Upon the occurrence of any abnormal extremes of temperature, or of severe gales, thunderstorms, snow-falls, important displays of aurora, or other phenomena of interest, particulars were immediately communicated to the local newspapers.

During the summer season (Whitsuntide to September 30th) the usual popular paragraphs as to the weather at Southport were supplied each evening (Saturdays excepted) to the local representatives of the Press Association, the *Liverpool Daily Post*, the *Liverpool Courier*, the *Liverpool Mercury*, and the *Leeds Mercury*. In addition, reports were despatched by train to the *Manchester Courier*, that newspaper defraying the cost of the carriage. The *Manchester Guardian*, the *Bradford Observer*, the *Yorkshire Post*, the *Sheffield Daily Telegraph*, and the *Birmingham Daily Gazette*, obtained our paragraphs from the Press Association. No information was supplied on Sundays for either the *Liverpool Courier*, or the *Manchester Courier*.

From the end of May, a telegram giving the total duration of Bright Sunshine between sunrise and 6 p.m., as recorded by the Campbell-Stokes instrument, was despatched each evening (Saturdays excepted) to the Meteorological Office, London, for the insertion of that information in the "Remarks" furnished by the Office at 8 p.m. to "a very large number of the more important papers and news agencies."

Exchanges.—A considerable number of valuable technical publications were received during the year from Directors of British and Foreign Observatories, Public Officials, and private individuals.

Much technical information and advice was furnished to a number of Corporations, District Councils, Meteorologists, and private persons.

The Annual Tabular Results.—With reference to the general Results of the Observations made during the year, which follow this administration report, it appears necessary to say but little here. Descriptive notes precede the Tables.

I may, however, remark that I have on the present occasion added columns in which the Monthly Means of Underground Temperature at one foot below the surface, and of Ozone, are compared with the local averages for past years; and also several columns containing the monthly results derived from the indications of the new and somewhat important instruments at Marshside and Downholland.

The *annual* statistical comparison with other Health Resorts, given on the last page of this pamphlet, has again been lengthened, *every* Health Resort in the United Kingdom known to possess a proper Meteorological Station being included.

The Frontispiece.—I have taken the liberty of prefixing to this Report a photo-lithographic reproduction of the record produced by the Dines Recording Pressure Tube Anemometer at the Marshside Station during the gale of January 12th, 1899.

I am, Gentlemen,

Your obedient Servant,

JOSEPH BAXENDELL,

Borough Meteorologist.

The Fernley Observatory, Southport,

February 17th, 1899.

SOUTHPORT

Meteorological Observatory.



RESULTS OF OBSERVATIONS

MADE DURING

THE YEAR 1898.

The Fernley Observatory, Southport.

The Geographical Position of the Hesketh Park or principal station of the FERNLEY METEOROLOGICAL OBSERVATORY is :—Latitude, $53^{\circ} 39' 24''$ N. ; Longitude, $2^{\circ} 59' 3''$ W.

The Fernley Louvred-Structure (containing one set of Shade Thermometers, the Fortin and Kew Barometers, the Aneroidograph, the Richard Thermograph, the Richard Hair Hygrograph, and the Ozone Test Papers), and also the Robinson Cup and the Dines Sight-Indicating Pressure Tube Anemometers, the Wind Vane, the Campbell-Stokes and the Jordan Sunshine Recorders, the old Evaporation-Gauge and Screen, and the Solar Thermometers, are erected upon the highest hill in Hesketh Park. The Stevenson-Screen, the Terrestrial Radiation and the Underground Thermometers, and the Raingauges, are planted to the N.W. of, and slightly below, the summit of the hill, upon or in an extensive and open, but not unduly exposed, green.

The Fortin-Standard and Kew-pattern-Station Barometers, the Aneroidograph, the various Thermometers, the ordinary Raingauges, and the Sunshine Recorders, have all been verified at Kew Observatory, and each reading is corrected for instrumental errors, *including* (as regards the Thermometers) *gradual zero displacement*.

The cisterns of the Barometers are 51 feet above the mean level of the sea.

The bulbs of the Dry, Wet, and Minimum Thermometers in the Stevenson-Screen are 4 feet above the grass, and the Maximum is slightly lower. The Screen is of the Royal Meteorological Society's pattern.

The Hygometrical Results are deduced from the *daily* readings of the Dry-bulb and Wet-bulb Thermometers, by means of the eighth edition of Glaisher's Tables.

The Underground Thermometers are suspended by chains in iron tubes sealed (except in the case of the 20-ft. Thermometer) at the lower ends and closed above the grass by copper caps. The instrument suspended 20 feet beneath the surface is one of Messrs. Negretti and Zambra's patent slow-acting Thermometers, having a specially open scale, and being divided on the stem to tenths of degrees.

The bulbs of the Solar Radiation Maximum Thermometers are placed five feet above grass. To the readings of the Blackened-bulb Thermometer *in vacuo* a special subtractive correction is applied, for the purpose of rendering the indications of the instrument strictly comparable with those of the Kew Observatory's standard Black-bulb Thermometer *in vacuo*.

The photographic traces of the Jordan Sunshine Recorder are "fixed" *before* being measured.

The Direction of the Wind is given according to *true*, and not to magnetic bearings. When the air is practically calm at the time of observing, the point at which the Vane is standing is noted, and entered as the approximate direction.

The cups of the Robinson Anemometer are five inches in diameter, and they are placed upon 12-in. arms.

The Ozone Test-Papers and Scale used are Moffat's, and are obtained from Messrs. Negretti & Zambra, London.

The upper edge of the receiver of the Raingauge (a Meteorological-Office-pattern one, eight inches in diameter, and constructed of copper) is one foot above the surface of the ground, and 38 feet above mean sea level; this gauge is read twice daily, viz., at 9 a.m. and 9 p.m. A 5-inch Snowdon Raingauge, similarly placed, is employed for weekly and monthly check observations. The Duration of the Rain is registered by Casella's Self-Recording Raingauge, as improved by Baxendell; the rim of this instrument is 4 feet 6 inches above the ground, and 42 feet above mean sea level.

The Fog and other related Results are derived from observations of the visibility of objects and lights at definite distances from the Observatory Hill.

The occurrence of Dew and Hoar-Frost is determined by the use of a thin compound board, painted white, and supported by 2-inch pegs over a stout oak board let into the sod.

Local Mean Time is employed for the Observations.

The Averages, with which a number of the results for 1898 are compared in the following Tables, are (with the exception of the ones for Sunshine and Ozone) those for the 25 years 1872-96 inclusive. The adopted *Jordan* Sunshine Averages are those for the six years 1892-7 inclusive; and the adopted Ozone Averages, those for the eight years, 1891-8 inclusive.

It seems scarcely necessary to add that the sign + in the columns headed "Difference from the Average" signifies that the 1898 value *exceeded* the average by the amount following the sign, and that the sign - similarly indicates that the result for 1898 was *below* the average to the extent stated.

Marshside Anemograph Station.

The Geographical Position of this Station is :—Latitude, $53^{\circ} 40' 18''$ N. ; Longitude, $2^{\circ} 58' 23''$ W. It is situated on the coast, over a mile to the N.N.E. of the Hesketh Park Observatory, viz., in the direction of the estuary of the Ribble, and is in an extensive, barren, reclaimed marsh, adjoining the beach.

The “head” of the Dines Recording Pressure Tube Anemometer is mounted at a height of 50 feet above the ground, and 40 feet above the roof of the Marshside Fog Bell brick hut. The instrument is constructed to record up to 120 miles per hour.

The vane of the Baxendell Recording Anemoscope is 40 feet above the ground.

Particulars regarding the SUB-STATIONS, and the instruments in use thereat, are appended to the respective Tables.

Every effort has been made to secure accuracy in the computations, in the preparation of the manuscript for the press, and in the printing.

Atmospheric Pressure.*

1898.	MEAN PRESSURE.		Difference from the Average (At Sea Level).	Observed Monthly Range.	Mean of Daily Observed Oscillations.	Difference from the Average.
	At 32 deg., and Station Level.	At 32 deg., and Mean Sea Level.				
January	30.180	30.237	+0.317	1.247	0.199	-0.055
February	29.829	29.886	-0.053	1.103	0.270	+0.039
March	29.873	29.931	+0.007	0.865	0.194	-0.031
April	29.812	29.868	-0.057	0.803	0.179	-0.004
May	29.786	29.842	-0.056	1.276	0.198	+0.036
June	29.923	29.978	-0.055	0.983	0.123	-0.038
July	30.065	30.121	+0.194	0.774	0.129	-0.027
August	29.917	29.972	+0.055	0.694	0.198	+0.026
September	30.008	30.064	+0.128	0.890	0.166	-0.016
October	29.747	29.802	-0.055	1.503	0.176	-0.049
November	29.751	29.807	-0.056	1.587	0.227	-0.029
December	29.886	29.943	+0.057	1.380	0.285	+0.016
Means.....	29.898	29.954	+0.033	1.092	0.195	-0.011

* From observations at 9 a.m. and 9 p.m. daily; no corrections being applied for diurnal range.

Temperature.

In the Fernley-Louvred Structure.

(For Stevenson-Screen Results, see next page.)

1898.	Mean Temperature.*	Difference from the Average.	Mean Daily Range.†	Difference from the Average.	Extreme Monthly Range.	Difference from the Average.	Day-to-day Mean-temp. Variability.	Difference from the Average.
	°	°	°	°	°	°	°	°
January	44.4	+6.1	6.1	-2.2	22.9	-6.5	3.1	+0.2
February	41.1	+2.0	7.6	-1.2	30.0	+2.3	2.9	+0.2
March	39.8	-1.1	10.0	-0.7	27.0	-3.9	2.4	+0.1
April	47.2	+1.7	12.2	-0.7	34.7	+1.4	2.2	+0.1
May	49.9	-0.7	10.4	-2.8	29.6	-4.9	2.0	-0.2
June	56.5	-0.2	11.3	-1.5	31.0	-3.8	2.3	+0.2
July	58.9	-0.2	9.8	-1.4	24.9	-4.1	1.7	-0.1
August	61.1	+2.3	11.4	+0.1	30.9	+1.0	2.5	+0.7
September	58.7	+3.4	12.0	+0.3	41.6	+10.5	3.2	+1.1
October	52.1	+4.0	8.5	-2.0	26.1	-5.7	1.9	-0.8
November	45.2	+2.2	8.1	-0.9	31.0	+2.3	2.9	0.0
December	46.2	+7.5	7.0	-1.6	28.0	-2.6	3.7	+0.6
Means	50.1	+2.3	9.5	-1.2	29.8	-1.2	2.6	+0.2

* Mean of daily 9 a.m. and 9 p.m. readings of Maximum and Minimum Thermometers, the instruments being "set" at both hours. † 24 hours ending 9 p.m.

Vapour Tension ; Relative Humidity of the Air ; and Underground Temperatures.

1898.	Mean Tension of Vapour.		Mean Relative Humidity of the Air.			Difference (at 9 a.m.) from the Average.	Mean Underground Temperatures at 9 a.m.				Difference (at 1 foot) from the Average.
	9 a.m.	9 p.m.	9 a.m.	1 p.m.	9 p.m.		1 foot.	4 feet.	10 feet.	20 feet.	
January	0·257	0·267	90	87	90	+2	41·9	43·0	46·76	.....	+4·9
February	·210	·220	81	77	82	-7	40·1	43·3	46·33	.....	+2·4
March	·202	·208	82	74	84	-2	40·2	42·4	45·48	.....	0·0
April	·262	·265	80	74	83	+1	46·9	46·1	45·85	.....	+1·3
May	·291	·290	76	71	83	0	52·7	50·6	47·76	.....	-0·5
June	·366	·370	77	74	82	0	60·2	56·3	50·43	.....	0·0
July	·380	·394	75	68	80	-4	64·3	60·4	53·55	.....	+0·8
August	·437	·428	79	72	80	-2	63·3	61·2	55·52	.....	+0·7
September	·413	·418	81	72	85	-1	59·9	60·4	56·44	.....	+1·7
October	·343	·339	88	80	87	+3	52·2	54·9	55·46	.....	+1·9
November	·264	·272	89	82	87	+1	45·8	50·7	53·31	.....	+2·3
December	0·274	0·264	87	84	84	-1	43·5	46·5	50·56	*	+5·1
Means	0·308	0·311	82	76	84	-1	50·9	51·3	50·62	.....	+1·7

* Instrument brought into use on December 16th.

Stevenson - Screen Results.

1898.	Mean Temperature.*	Mean Daily Range of Temperature.	Absolute Extremes of Temperature.				No. of Days with Frost.	Mean Relative Humidity of the Air.	
			Highest. Temp.	Date.	Lowest. Temp.	Date.		9 a.m.	9 p.m.
January	44·3	7·1	55·3	30th	30·9	10th	1	89	91
February	41·2	9·2	55·3	1st	23·0	21st	6	82	84
March	40·1	12·0	55·4	18th	26·4	8th	13	82	84
April	47·0	14·2	68·1	8th	28·5	5th	2	80	83
May	50·1	12·0	67·8	23rd	34·0	15th	0	76	84
June	56·2	13·2	73·8	10th	40·9	14th	0	76	84
July	58·5	12·0	72·1	22nd	44·0	25th	0	74	82
August	61·2	12·8	80·4	12th	46·1	25th	0	80	82
September	58·9	13·8	80·0	5th	35·2	25th†	0	82	87
October	52·4	10·0	67·3	3rd	35·9	12th	0	89	90
November	44·9	9·3	59·5	2nd	26·3	29th	4	90	88
December	45·8	7·7	58·9	5th	30·0	30th†	3	88	84
Means	50·1	11·1	HIGHEST. 80·4	AUGUST 12th	LOWEST. 23·0	FEB. 21st	TOTAL. 29	82	85

* The Temperatures here given are the means of the daily indications (each for the 24 hours ending at 9 p.m.) of the Maximum and Minimum Thermometers in the Screen.

† And also on the 26th.

† And also on the 31st.

Solar and Terrestrial Radiation.

1898.	Mean Daily Max. Temp. in Sun.			Mean Excess of Blackened-bulb in Vacuo, over Bright-bulb in Vacuo.	Mean Excess of Blackened-bulb in Vacuo, over Day-period Max. in Shade.	Mean Excess of Black-glass bulb in Open Air, over Day-period Max. in Shade.	Mean Daily Min. * on Short-Grass or Snow.	Mean Night-period Depression of Min. on Grass or Snow, below Min. in Screen.
	Blackened-bulb In Vacuo.	Bright-bulb In Vacuo.	Black-glass bulb in Open Air.					
January	60·7	51·3	49·5	9·4	13·7	2·4	37·3	2·7
February.....	81·9	56·8	50·8	25·1	37·5	6·2	32·3	3·4
March	88·9	59·8	53·1	29·1	43·9	8·1	29·3	3·9
April	96·2	67·8	60·8	28·4	43·1	7·6	35·1	3·3
May.....	104·5	73·1	65·9	31·4	49·3	10·5	40·6	2·8
June	115·0	80·9	74·2	34·1	53·2	12·4	46·5	2·2
July	119·5	84·2	77·0	35·3	56·0	13·5	47·9	3·7
August.....	111·8	82·3	76·7	29·5	45·4	10·2	51·0	2·7
September ...	103·9	78·2	73·0	25·7	39·3	8·3	46·6	4·2
October	84·9	65·6	62·5	19·3	28·3	5·9	42·0	4·2
November ...	71·8	55·9	53·0	15·9	22·7	3·9	32·9	5·5
December	66·1	54·2	51·5	11·9	16·9	2·0	35·1	6·1
Means	92·1	67·5	62·3	24·6	37·4	7·6	39·7	3·7

* From the indications of a *sensitive* Minimum Thermometer.

Duration of Bright Sunshine; and Amount of Cloud.

1898.	PER STANDARD RECORDER (CAMPBELL-STOKES).				PER JORDAN PHOTOGRAPHIC RECORDER.				Mean Amount of Cloud.	Difference of Mean of 9 a.m. and 9 p.m. from the Average.	
	Total Bright Sunshine.	Most Sunshine in One Day.	Number of Sun-less Days.	Total Bright Sunshine.	Difference from the Average.*	Most Sunshine in One Day.	Number of Sun-less Days.	9 a.m.	1 p.m.	9 p.m.	
January	Hours. Hours.	Hours. Hours.	Hours. Hours.	Hours. Hours.	Hours. Hours.	Hours. Hours.	Hours. Hours.	o to 100 to 100 to 10	o to 100 to 100 to 10	o to 100 to 100 to 10	+1·8
January	25 5·7	27th	21 25	—20	5·9	27th	19 9·3	9·0	8·8	9·0	+1·8
February.....	96 9·3	23rd	3 99	+44	8·9	23rd	3 7·0	6·8	6·9	6·8	+0·2
March	147 11·4	20th	2 152	+10	11·3	20th	2 7·5	6·3	6·0	6·3	+0·3
April	146 12·7	16th	2 159	—42	12·9	16th	2 7·2	6·7	6·2	6·7	+0·2
May	213 14·1	12th	3 208	—36	13·7	12th	3 6·5	6·8	7·4	6·8	0·0
June.....	192 14·5	10th†	0 201	—29	13·8	28th	0 7·2	6·5	7·0	6·5	0·0
July	234 15·7	4th	1 240	+22	14·5	4th	1 6·9	5·6	6·1	5·6	—0·9
August.....	135 11·9	14th	2 149	—23	12·8	14th	2 6·9	6·7	6·4	6·7	—0·6
September ...	130 10·8	16th	5 141	0	10·8	16th	3 7·5	6·0	5·2	6·0	—0·3
October	68 8·1	12th	10 71	—29	8·2	12th	10 7·9	7·6	7·2	7·6	+0·6
November ...	59 6·8	22nd	7 55	+13	6·5	22nd	8 8·4	7·8	8·0	7·8	+1·1
December ...	34 6·0	30th	12 35	+ 9	5·8	30th	11 8·5	8·2	7·3	8·2	+0·6
Totals	MOST. 1479	JULY 15·7	4th 68	1535	—81	MOST. 14·5	JULY 4th	64	7·6	7·0	6·9
	MEAN.	MEAN.	MEAN.	MEAN.	MEAN.	MEAN.	MEAN.	MEAN.	MEAN.	MEAN.	+0·2

* Approximate Sunshine Averages only are available. [See the Explanatory Remarks preceding these Tables.]
† And also on the 28th.

Direction and Velocity of the Wind.*

1898.	DIRECTION OF THE WIND.—From Observations at 9 a.m. and 9 p.m. daily.								Mean Daily Movement of the Wind.	Difference from the Average.
	N.	N.E.	E.	S.E.	S.	S.W.	W.	N.W.		
	%	%	%	%	%	%	%	%	MILES.	MILES.
January	0	0	3	21	30	29	15	2	197	- 110
February.....	10	4	4	3	11	13	43	12	399	+ 113
March	15	12	16	11	8	9	19	10	289	- 23
April	1	7	7	21	28	13	20	3	254	- 12
May	4	9	17	8	5	3	34	20	290	+ 37
June	6	11	5	10	12	17	25	14	235	+ 5
July	6	4	11	1	2	6	43	27	258	+ 16
August.....	9	4	10	13	12	21	18	13	260	+ 17
September ...	4	5	11	26	13	20	20	1	223	- 15
October	2	12	19	24	21	12	9	1	232	- 31
November....	12	6	11	28	18	13	12	0	251	- 44
December	6	4	0	16	22	26	20	6	387	+ 92
Means	6	7	10	15	15	15	23	9	273	+ 4

* From the indications of the older (non-recording) instruments, in Hesketh Park. The results obtained by means of the new standard self-recording instruments on the coast appear upon a subsequent page, under the heading "Marshside Anemograph Station."

Direction of the Wind; and Amount of Ozone.

1898.	DIRECTION OF THE WIND.—Difference from the Average.								Mean Ozone Registered in 12 hours.	Difference from the Average.
	N.	N.E.	E.	S.E.	S.	S.W.	W.	N.W.		
									o to 10.	
January	- 5	- 6	- 10	- 7	+ 15	+ 11	+ 6	- 4	1.7	- 1.9
February.....	+ 4	- 4	- 12	- 19	- 4	- 4	+ 33	+ 6	4.8	+ 1.0
March	+ 8	+ 3	+ 3	- 6	- 5	- 11	+ 6	+ 2	3.9	- 0.8
April	- 8	- 9	- 11	+ 6	+ 18	0	+ 9	- 5	3.5	- 0.8
May	- 4	- 5	+ 4	- 4	- 5	- 14	+ 18	+ 10	5.6	+ 0.1
June.....	+ 2	+ 2	- 5	- 3	0	- 4	+ 3	+ 5	5.3	0.0
July	+ 3	- 2	+ 4	- 11	- 11	- 20	+ 20	+ 17	5.6	+ 0.3
August.....	+ 5	- 4	- 1	0	- 1	- 1	- 1	+ 3	4.1	- 0.9
September ...	- 1	- 3	- 2	+ 8	0	+ 2	+ 5	- 9	3.2	- 0.7
October	- 7	+ 1	+ 7	+ 4	+ 8	- 2	- 3	- 8	1.2	- 1.9
November....	+ 3	- 3	- 3	+ 6	+ 5	- 1	+ 2	- 9	1.4	- 1.1
December	0	- 2	- 13	- 8	+ 9	+ 8	+ 9	- 3	3.2	+ 0.1
Means	0	- 2½	- 3½	- 3	+ 2½	- 3	+ 9	+ 0½	3.6	- 0.6

Rainfall.

1898.	Total Rainfall.*	Difference from the Average.	No. of days† with Rain (0.005 in. or more).	Difference from the Average.	Greatest Fall in One Day.†		‡ Night-period Rainfall, per cent. of Total Fall.	Total Duration of Rain.	Mean level of Subsoil Water.‡
					Amount.	Date.			
January	2.62	-0.09	15	+ 2	0.82	4th	60	73	33.0
February	2.18	+0.20	21	- 6	0.36	3rd	63	41	34.0
March	0.91	-1.28	10	- 5	0.32	28th	46	25	36.5
April	1.98	+0.35	11	- 2	0.70	11th	68	37	37.9
May	3.26	+1.17	14	0	0.47	10th	37	56	39.6
June	1.85	-0.43	12	- 1	0.42	23rd	35	32	42.2
July	0.35	-3.26	5	-11	0.21	1st	43	9	47.0
August	5.14	+1.34	17	0	0.85	9th	59	54	48.1
September	1.48	-2.02	10	- 6	0.73	29th	45	23	49.9
October	3.46	-0.51	16	- 2	0.60	28th	61	55	49.5
November	3.02	-0.26	18	0	0.53	22nd	72	58	42.7
December	2.48	-0.60	23	+ 5	0.66	26th	60	50	39.6
Totals	28.73	-5.39	172	-18	GREATEST. 0.85	AUGUST 9th	MEAN. 54	513	MEAN. 41.7

* From 9 a.m. on the 1st; including each month the fall during the first nine hours of the succeeding month. † 24 hours ending at 9 a.m. next day. ‡ 9 p.m. to 9 a.m.

§ Mean distance below the surface of the ground. The measurements are made daily.

Miscellaneous Phenomena.

1898.	At one or both of the Chief Observing Hours.*										At any Hour.					
	Thick Fog.	Slight Fog and Mist.	Sea Fog.	Sky or Dust Haze.	Clear Air.	Clear Sky.	Dew.	Hoar-Frost.	Solar Halos.	Lunar Halos.	Thunder-Storms	Lightning. only.	Hail.†	Snow.	Total Depth of Snow.	Frost on the Grass.
January ...	0	25	24	18	4	1	11	4	1	0	0	0	0	0	0.0	8
February ...	0	8	8	7	11	6	4	7	2	0	0	0	4	1	0.2	11
March	4	15	14	13	14	7	14	4	1	0	0	1	0	4	0.3	23
April	0	8	11	14	12	4	15	0	2	2	1	0	0	0	0.0	9
May	0	6	10	8	21	5	6	0	4	0	2	1	3	0	0.0	3
June	0	1	1	9	23	4	10	0	3	0	2	0	1	0	0.0	0
July	0	2	2	11	28	9	7	0	1	0	0	0	0	0	0.0	0
August	0	5	8	12	18	2	11	0	1	0	4	1	0	0	0.0	0
September..	0	11	13	13	13	5	20	0	0	0	1	0	0	0	0.0	4
October ...	1	15	15	8	9	4	18	0	0	0	2	1	0	0	0.0	2
November ..	1	18	21	16	8	3	17	5	1	1	0	0	0	2	6.2	13
December ..	1	11	12	6	18	5	9	4	0	1	0	0	0	0	0.0	12
Totals	7	125	139	135	179	55	142	24	16	4	12	4	8	7	6.7	85

* 9 a.m. and 9 p.m. † Including "Soft-Hail."

Marshside Anemograph Station.

1898.

DIRECTION OF THE WIND.
From the Hourly Tabulations of the Charts from the Baxendell Recording Anemoscope. Reduced to per centages.

MOVEMENT OF THE WIND.

Per Dines Recording Pressure Tube Anemometer.

	N. N.E. E. S.E. S. S.W. W. N.W.								Mean Daily Movement.	Absolute Max. in 1 Hour.	Rate in Max. Gust.
	%	%	%	%	%	%	%	%	Miles.	Miles.	Miles per hr.
January									286	43	59
February									458	50	63
March									342	46	62
April									297	38	52
May									318	44	60
June									275	32	42
July	7	3	7	6	2	4	38	33	307	33	40
August	3	3	17	11	10	13	21	22	309	41	57
September	4	3	10	23	13	13	23	11	272	38	47
October	3	8	26	20	15	9	13	6	257	37	50
November	12	5	15	20	20	9	16	3	282	42	53
December	4	1	2	15	20	23	21	14	415	45	62
Means									318	HIGHEST. 50	HIGHEST. 63

Downholland Station.*

1898.

Level of Downholland Brook. ‡

Mean Daily Min. Temp. on Grass.

	Total Rain-fall.	Total Evapo-ration †	Mean Height. §	Highest Level.				Lowest Level.				o
				Inches	Inches.	Ft. Ins.	Ft. Ins.	Height.	Dates.	Height.	Dates.	
January				10	4	13	2	6th		9	5	28th and 29th
February				9	8	10	0	||		9	4	24th and 25th
March				9	3	9	11	2nd		9	0	25 to 28 and 30
April				9	2	10	0	12th		9	0	1st to 10th
May				9	6	11	0	22nd and 23rd		9	0	4th to 10th
June				9	3	10	0	2nd		8	11	17th to 21st
July				8	11	9	1	3rd		8	11	10th to 31st
August				9	5	10	0	28th to 30th		9	0	1st to 3rd
September				9	2	9	5	1st		8	11	23rd to 30th
October				9	4	10	11	31st		8	11	16th and 17th
November	2.55	0.17		10	7	12	4	4th		9	7	22nd
December	2.29	0.91		10	0	11	8	30th		9	7	38.2
			MEAN.	HIGHEST.		JANUARY		LOWEST.		JUNE, JULY, SEPT., AND OCT.		MEAN.
Totals			9	7	13	2	6th	8	11			

* On Barton Moss, adjoining Formby Moss; 14 feet above Ordnance datum.

† From a Symons ground Tank, six feet square and two feet in depth, sunk in a very openly exposed situation. The height of the water is measured daily by a hook gauge.

‡ North-west of Mossbridge Station on the Southport and Cheshire Lines Extension Railway.

§ Above Ordnance datum. || 2nd, 5th, 7th, 8th, and 9th. ¶ 16th, 17th, 24th, and 25th.

Pierhead, Birkdale, and Ashurst's Beacon Sub-Stations.

1898.	Mean Temperature of Sea at Southport Pierhead. *	Mean Temperature of Sea at North-West Lightship. †	Main Disturbance of the Sea off Southport. *	BIRKDALE. ‡	ASHURST'S BEACON. ||
				Total Rainfall.	Total Rainfall.
January.....	43.7	46.3	0 to 9.	2.55	28.9
February.....	42.0	43.9	3.1	2.05	31.9
March.....	41.4	43.0	2.0	0.99	35.4
April.....	46.9	45.8	2.1	1.94	34.9
May.....	51.9	49.5	2.0	3.66	35.2
June.....	59.1	54.0	2.0	1.92	37.7
July.....	62.6	59.6	1.9	0.35	42.8
August.....	62.9	61.9	1.9	5.07	41.8
September.....	60.2	61.0	1.6	1.45	44.5
October.....	53.3	53.4	1.5	3.66	43.0
November.....	47.6	52.4	2.0	2.68	33.5
December.....	45.2	48.3	3.0	2.46	33.1
Means.....	51.4	51.6	2.1	TOTAL. 28.78	TOTAL. 32.19

* These results are obtained through the courteous assistance of the Southport Pier Company Limited. The daily hour of observation is 11 a.m.

† Copies of the observations of Sea-Surface Temperature made at the Liverpool N.W. Lightship are kindly supplied to this Observatory from the Meteorological Office, London.

‡ 29 feet above Ordnance datum.

§ Mean distance below the surface of the ground. The measurements are made daily.

|| 538 feet above Ordnance datum.

Rainfall in the District.*

1898.	COASTLINE.						INLAND.		HILLS.
	Black-pool.	South-port.	Birkdale.	Blundell-sands.	New Brighton.	Hoylake.	Rufford.	Aughton.	Ashurst's Beacon.
ALTITUDE.	59 ft.	22 ft.	29 ft.	33 ft.	130 ft.	30 ft.	39 ft.	150 ft.	538 ft.
January.....	3.03	2.62	2.55	2.03	1.74	1.43	2.71	2.31	2.71
February.....	1.94	2.18	2.05	1.78	1.67	2.40	2.15	1.94	2.79
March.....	0.47	0.91	0.99	0.62	0.76	0.70	0.99	1.08	1.61
April.....	2.27	1.98	1.94	1.73	1.92	1.42	2.00	1.67	2.29
May.....	4.35	3.26	3.66	3.73	4.19	4.20	3.60	4.00	4.05
June.....	2.02	1.85	1.92	1.97	2.31	1.96	2.60	1.93	2.54
July.....	0.52	0.35	0.35	0.35	0.41	0.63	0.53	0.42	1.24
August.....	5.32	5.14	5.07	4.18	3.76	3.66	5.71	5.02	4.38
September.....	1.58	1.48	1.45	1.33	1.16	1.39	1.22	1.42	1.78
October.....	4.04	3.46	3.66	2.64	3.66	3.11	3.78	3.81	3.97
November.....	3.43	3.02	2.68	2.97	1.82	1.69	3.57	2.73	2.99
December.....	3.86	2.48	2.46	1.86	1.79	1.91	2.98	2.21	1.84
Totals.....	32.83	28.73	28.78	25.19	25.19	24.50	31.84	28.54	32.19

* The Results from Blackpool, Blundellsands, New Brighton, Hoylake, Rufford, and Aughton, given in the above Table, have been kindly furnished respectively by the Corporation of Blackpool (per Dr. A. Jasper Anderson, M.A., Medical Officer of Health); Mr. T. Mellard Reade, C.E.; Mr. W. Bell, J.P.; the Urban District Council of Hoylake and West Kirby (per Mr. T. Foster, Surveyor); Mr. T. Hobkirk; and Mr. C. E. Maples.

Extremes for the Year.

The highest *observed reading* of the Barometer at Southport during the year 1898 (reduced to 32 degrees, at mean sea level) was 30.609 inches on January 15th, at 9 p.m. The lowest was 28.780 inches on November 25th, at 9 a.m. The (corrected, etc.) *absolute extremes*, as deduced from the Aneroidograms, were, respectively, 30.61 inches on January 15th, at 10 p.m., and 28.78 inches on November 25th, at 9 a.m.

The highest temperature registered in the Fernley Louvred-Structure during the year was 79.2 degrees on August 12th. The lowest was 24.9 degrees on February 21st. The respective extremes in the Stevenson-Screen were 80.4 degrees on August 12th, and 23.0 degrees on February 21st.

The highest reading of a black-glass-bulb solar radiation maximum thermometer in open air was 88.7 degrees on September 7th. The highest reading of a blackened-bulb thermometer *in vacuo* was 133.8 degrees on July 31st. The greatest difference between the maximum indications on the same day of the shade thermometer and the blackened-bulb thermometer *in vacuo* was 68.7 degrees on July 31st. The greatest difference between the maximum indications upon the same day of the bright-bulb and the blackened-bulb thermometers *in vacuo* was 42.1 degrees on July 31st.

The lowest temperature registered on the grass by Hicks' "Cylinder-Jacket-bulb" terrestrial radiation minimum thermometer was 14.0 degrees, early on November 29th.

The greatest general thickness of the ice over the large lake in Hesketh Park was 0.3 inches on February 24th. The lake was either partially or entirely covered with ice in February upon 2 days, in March on 1 day, in November on 2 days, and in December on 1 day.

The day of highest mean temperature in the Fernley Louvred-Structure was September 5th, and the value for that day was 70.0 degrees. The day of lowest mean temperature was February 21st, and the value for that day was 31.7 degrees.

The greatest range of temperature upon one day in the Fernley Louvred-Structure was 25.3 degrees on August 12th. The least was 1.8 degrees on May 9th.

The greatest difference between the adopted mean temperatures of any two consecutive days was a decrease of 12.0 degrees from November 18th to 19th.

The lowest and highest 9 a.m. temperatures of the ground, at the depth of one foot below the surface, were, respectively, 35.0 degrees on February 25th, and 67.5 degrees on July 17th. The extremes at the depth of four feet were 41.1 degrees from March 10th to 12th, and 62.0 degrees on August 18th to 25th; while those at ten feet beneath the surface were 45.19 degrees on March 23rd, and 56.66 degrees from September 25th to 28th.

The lowest relative humidity of the air at any one of the usual observing hours (viz., 9 a.m., 1 p.m., and 9 p.m.) was 45 on April 18th, and July 20th, at 1 p.m. Complete saturation was recorded on 5 occasions.

The greatest duration of bright sunshine (per standard Campbell-Stokes recorder) upon one day was 15.7 hours on July 4th. The greatest duration of sunshine (per Jordan recorder) on one day was 14.5 hours on July 4th.

The heaviest fall of rain in any one "rainfall day" (i.e., 24 hours ending at 9 a.m. next day) was 0.85 inches on August 9th.

At the Marshside Anemograph Station, the greatest total movement of the wind in one day (24 hours ending at midnight) was 1040 miles on February 2nd. The greatest movement in one hour was 50 miles on February 2nd, at 4 p.m., the direction at the time being W. by N. The rate of movement during the strongest momentary gust was 63 miles per hour on February 2nd, at 4.33 p.m., the direction being W. by N.

Main Features of the Months.

1898.

JANUARY.

The mildest and most cloudy January during the 27 years' local record, owing to the persistence of a type of pressure distribution over Western Europe occasioning continuous southerly and south-westerly currents over the British Islands. Mean temperature no less than 6 degrees above the average for the 25 years, 1872-96. Frost in the Stevenson-Screen on 1 day only, and upon the grass on 8 days. Mean daily range of temperature smaller than in any month whatever since the record commenced in July, 1871, and oscillations of atmospheric pressure extremely small. Absolute maximum and minimum temperatures both abnormally high. Light south-easterly and south-westerly airs and calms practically throughout the month. Rainfall normal; the bulk of the fall, however, occurring during the first week. Much haze and slight fog in consequence of the southerly weather, and an altogether exceptional prevalence of cloud, the duration of sunshine amounting to very little more than half the average. Sea remarkably warm. A fresh to strong westerly gale during the night of the 30th to 31st.

FEBRUARY.

Upon the whole a rather mild and stormy month, but exceptionally sunny. Mean temperature 2 degrees above the normal. Very warm on the 1st; cold, keen weather from the 21st to the 24th, inclusive. Frost in the Screen on 6 days, and upon the grass on 11 days. A remarkable prevalence of strong westerly winds, and a corresponding deficiency of easterly and south-easterly airs. Mean relative humidity of the air, from some cause, exceptionally low. Rainfall normal, but spread over a large number of days. A very considerable amount of sunshine, and much clear air. Ozone unusually abundant. Sea warm, especially during the first three weeks. Gales on several occasions; the only one of any moment, however, being a strong to nearly a whole gale, which prevailed practically throughout the 2nd. A parhelion on the 21st. Slight snow on the 4th. Hail or soft-hail on the 6th, 7th, 20th, and 26th, the fall on the 20th being a heavy one, which lay upon the ground for some days. Thin ice on the large lake in Hesketh Park on 2 days.

MARCH.

A dry, but otherwise normal month. Mean temperature 1 degree below the average. Frost in the Screen on 13, and upon the grass on 23 days. A general deficiency of southerly airs, and a trying spell of unusually dry and keen strong north-easterly winds from the 23rd to the 27th. Rainfall scarcely an inch, and $1\frac{1}{4}$ inches under the average. Normal amounts of cloud and sunshine. A good deal of ozone. Westerly gales on the 1st and 2nd, and north-easterly gales on the 23rd, 24th, 25th, 26th, and 27th. Moderate to thick fog on the mornings of the 9th, 11th, 12th, and 13th. Lightning on the night of the 1st. Excessively light showers of snow on the 6th, 24th, 25th, and 26th. Thin ice on the lake in Hesketh Park on the 8th. Auroral light on the night of the 15th. Gloom at times during the last or nearly the last few days of the month.

APRIL.

A somewhat dull, mild month. Mean temperature $1\frac{3}{4}$ degrees above the average. Unusually warm on Good Friday (the 8th), the maximum temperature for the day in the Screen being 68.1 degrees. Frost in the Screen on 2 days, and upon the grass on 9 days. A very marked prevalence of southerly winds, of variable strength. Rainfall slightly in excess of the average, but largely confined to the second week. A rather serious deficiency of sunshine, but a satisfactory amount of ozone. A south-westerly gale on the evening of the 30th. Lightning and thunder upon the afternoon of the 29th.

MAY.

A decidedly wet and sunless month, with low *day*-temperatures and strong, cool winds. Barometer rather low and unsteady. Mean temperature three-quarters of a degree under the average. Highest readings from the 22nd to the 24th. Frost upon the grass on 3 nights, but none in the Screen. Daily range of temperature unusually small. A marked predominance of strong to moderate westerly, north-westerly, and easterly winds; southerly airs being almost entirely absent. Rainfall over an inch in excess of the average. A material deficiency of sunshine, but a clear air and a very large amount of ozone. A strong westerly gale on the 11th. Hail showers on the 11th, 12th, and 13th. Thunderstorms upon the 22nd and 24th.

JUNE.

Another rather sunless month, with some strong, cool breezes and generally low *day*-temperatures. Fairly normal, however, in nearly all other respects. Mean temperature practically equal to the average. Daily range small. No frost on the grass. Highest temperatures on the 10th and 11th. A decided preponderance of westerly winds. Rainfall half-an-inch below the average. As in May, a material deficiency of sunshine, but a very

clear air and an abundance of ozone,—all results of the westerly breezes and of a somewhat lower barometer than usual. Hail showers on the 2nd, and, at Downholland, on the 1st and 24th also. Thunderstorms on the 25th and 26th.

JULY.

The driest July on record locally. Barometric pressure steady and exceptionally high for the time of year. An overwhelming prevalence, however, of strong to normal westerly to north-westerly winds. Mean temperature consequently almost exactly equal to the average, and range of temperature moderate. No high readings. Total rainfall only 0.35 inch, or 3.26 inches below the average, and 0.19 inch below the record for the driest previous July (viz., that of 1878) during 27 years. Days with rain only 5, or 2 fewer than the least previous July number (in 1878). An absolute drought from the 2nd to the 17th inclusive. Relative humidity unusually low. Underground water falling steadily and considerably. Ozone very abundant. A decidedly good record of bright sunshine, and an almost continuously clear air. A moderate gale from west-north-west from 1 a.m. to 9 a.m. on the 3rd.

AUGUST.

A decidedly wet and sunless month, westerly winds predominating. Mean temperature, however, $2\frac{1}{4}$ degrees above the average. Night-temperatures unusually high. Warmest days:—12th, 21st, and 22nd, but no maximum above 80.5 degrees. Strong westerly winds and gales during the early part of the month and towards and at its close; very light, variable breezes through the intervening period. Total rainfall over 5 inches, being more than $1\frac{1}{4}$ inches in excess of the average. Ozone abundant during the stormy weather. A material deficiency of sunshine. Moderate gales on the 10th, 28th, and 29th; and fresh gales on the 5th, 27th, 30th, and 31st. Thunder on the 11th and 15th; and thunderstorms on the 19th and 21st.

SEPTEMBER.

A dry and very warm month. Mean temperature $3\frac{1}{2}$ degrees above the average. Highest readings on the 5th, 6th, 7th, 16th, and 17th; but absolute maximum only 80.0 degrees (on the 5th), in very marked contrast to the abnormal temperatures experienced on numerous days in the month over extensive portions of Great Britain, and especially in the south-eastern counties of England. Cool during the last week, frost occurring upon the grass on 4 nights. Mean day-to-day temperature-variability materially greater than in any previous September since the commencement of the record in 1871. Sea warm and calm. Normal September winds. Rainfall 2 inches below the average, and brooks and underground water becoming very low. A satisfactory amount of ozone; but a slight deficiency of sunshine. Moderate to fresh gales on the 18th and 27th. A distant thunderstorm on the evening of the 3rd. Brilliant aurora upon the night of the 9th. Slight fog at 9 p.m. on the 30th.

OCTOBER.

The warmest October on record locally, but also one of the most sunless. Notable, too, for exceptional equability of temperature. Mean temperature 4 degrees above the average, and half-a-degree above the value for the warmest previous October (viz., 1886) since the Observatory was established in 1871. Frost upon the grass on 2 nights only, and none in the shade. Mean daily range of temperature nearly, and mean day-to-day variability absolutely, the lowest in the 28 years. Winds easterly almost continuously through the first 3 weeks, and southerly to westerly subsequently. Very little rain during the earlier half of the month; practically daily falls afterwards, with stormy weather at intervals. Total rainfall half-an-inch below the average. Air damp. Brooks and sub-soil water, until the 17th, remarkably low for October, but ultimately rising rapidly. Very little ozone. A great deficiency of sunshine. Sea quiet and extremely warm. A moderate gale on the 24th to 25th, and a moderate to fresh gale on the 30th to 31st. Thunder on the 11th and 24th, and lightning upon the evening of the 11th. Slight to moderate fog on the morning and night of the 3rd, and on the mornings of the 4th and 10th.

NOVEMBER.

Exceptionally warm during the first 18 days; much cooler afterwards. Mean temperature $2\frac{1}{4}$ degrees above the average. Frost in the Stevenson-Screen on 4 days, and upon the grass or snow on 13 days. Variable winds. Rainfall slightly under the average. Extremely little ozone after the first week. A decidedly good record of sunshine. Fresh westerly gales on the 3rd, 4th, and morning of the 5th. Heavy snow from 1 a.m. until 9-15 a.m. on the 23rd, the total depth being 6.0 inches; slight snow-showers on the afternoon of the 29th. Ice upon the lake in Hesketh Park on the 28th and 29th. Slight fog on the 10th, 15th, and morning of the 16th; dense fog on the morning of the 19th.

DECEMBER.

An unprecedentedly warm month, the mean temperature exceeding that of any December, January, February, or March during the 27 years' local record! Highest readings on the 4th to 6th; lowest on the 23rd, 30th, and 31st. Mean temperature no less than $7\frac{1}{2}$ degrees above the average, and $3\frac{1}{4}$ degrees higher than that of the warmest December in the previous 27 years. Absolute maximum in shade, absolute minimum in shade, mean 1-ft. underground, and mean lake and sea temperatures each materially above the highest values recorded for December since the Observatory was established in 1871. Frost in the Stevenson-Screen on 3 days only, and upon the grass on 12 days. Wind movement very considerable, being greater than in any previous December during the 27 years. A marked absence of north-easterly currents, and a great prevalence of southerly to westerly winds. Total rainfall half-an-inch below the average, but spread over an unusual number of days. Much ozone. A good record of sunshine. Air frequently very

clear. Strong gales on the 2nd, 10th, and 27th; a fresh gale on the 28th; and moderate gales on various days. Some ice on the lake in Hesketh Park on the morning of the 31st. Thick fog on the night of the 21st, and slight fogs on the mornings of the 13th and 17th.

THE YEAR.

An exceptionally warm and decidedly dry year; but somewhat sunless. Remarkably mild during January and December, and very warm in September and October. Mean daily range of temperature small. An unusually large amount of bright sunshine in February, but material deficiencies in January, April, May, June, August, and October. Excessively dry in July, and rainfall decidedly below the average also in March and September; wet in May and August. A remarkable prevalence of westerly winds generally; stormiest months, February and December. Mean temperature of the year 2.3 degrees above the local average; total duration of bright sunshine 81 hours below the average; total rainfall 5.39 inches below the average.

Comparison with Other Health Resorts, 1898.

STATION.	Mean Temperature.		Mean Daily Range of Temperature.	Mean Relative Humidity of the Air at 9 a.m.	Total Rainfall.	Total Duration of Bright Sunshine.	Authority supplying the Statistics to this Observatory.
	The Year.	June to Sept. inclusive.					
Southport	50·1	58·7	11·1	82	28·73	1479	J. Baxendell.
Strathpeffer Spa ...	46·8	55·1	12·8	83	32·52	1200	Dr. J. T. Fox.
Oban	50·1	58·4	9·8	84	65·73	*	Dr. E. Baily.
Rothesay	49·2	56·8	||	||	46·57	*	J. Kay.
Ramsey	51·3	59·0	11·1	*	34·73	*	Dr. F. S. Tallet.
Scarborough	49·2	57·2	11·3	83	23·84	1313	E. W. Ellerbeck.
Grange-over-Sands.	*	*	*	*	46·57	1576 †	Dr. W. M. Burman.
Douglas.....	49·8	57·2	10·6	88	38·44	1566	A. W. Moore, M.A., S.H.K.
Morecambe	49·5	57·4	12·5	83	32·45	1633 †	T. B. Lamb.
Blackpool	50·2	58·7	12·5	81	32·83	1386	Dr. A. J. Anderson, M.A.
Hoyleake.....	†	†	†	†	24·50	†	T. Foster.
Llandudno	51·2	59·4	10·6	78	31·27	1610	W. Little.
Colwyn Bay	51·9	60·1	11·2	76	30·84	1643	Dr. R. E. Lord, B.Sc.
Buxton	47·4	57·0	14·8	81	44·30	1139 †	Dr. H. L. Apthorp.
Lowestoft	50·1	59·2	11·3	80	22·54	†	S. H. Miller.
Aberystwith	51·6	59·6	9·5	83	39·16	1467 †	Dr. A. Thomas.
Leamington Spa ...	51·7	61·9	14·9	80	18·69	*	J. Barnitt.
Malvern.....	50·3	59·7	11·8	80	22·19	*	A. Mander.
Killarney	51·6	59·7	12·3	85	54·58	*	Archdeacon Wynne, D.D.
Cheltenham	50·4	60·0	15·7	82	24·23	†	R. Tyrer, B.A.
Tenby	51·7	59·9	11·6	82	39·99	1632 §	W. T. Balmer.
Margate.....	51·6	61·4	11·6	80	18·77	1626	J. Stokes.
Bath	51·9	60·8	13·6	81	24·58	*	S. W. Arnold.
Weston-super-Mare	52·8	61·5	9·8	83	22·68	*	W. E. Perrett.
Ilfracombe.....	52·8	60·7	8·3	81	33·23	*	M. W. Tattam.
Tunbridge Wells ...	50·3	60·2	14·2	81	23·39	1732 †	Royal Met. Society.
Folkestone.....	51·4	60·5	10·9	81	21·95	1721 †	M. G. Y. Bateman.
Bude	52·0	60·6	13·1	85	31·52	*	J. Arthur.
St. Leonards-on-Sea	51·4	60·6	11·0	?	23·03	1731	Dr. H. Colborne.
Bexhill-on-Sea	51·1	59·9	11·2	85	20·17	1909	Miss A. Scrivens.
Brighton	52·6	61·9	11·9	80	20·41	1580	Dr. A. Newsholme.
Worthing	?	60·7	?	?	22·51	†	R. Met. Soc., & Dr. C. Kelly.
Bognor	51·4	60·1	11·1	81	18·66	1760 †	Dr. H. C. C. Morris.
Eastbourne	51·9	60·6	10·1	82	22·93	1768	R. Sheward.
Osborne	52·4	62·5	14·8	84	25·58	*	R. Scott.
Ryde	53·8	63·9	10·3	80	27·29	*	T. C. Flower.
Sidmouth	51·5	60·3	10·6	81	25·87	1660	Dr. W. Radford.
Totland Bay	51·7	60·4	9·8	85	25·60	*	J. Dover, M.A.
Weymouth	52·2	60·9	10·1	80	21·70	1828	I. J. Brown.
Ventnor	52·5	61·1	10·7	79	24·52	1726	Miss M. Gibson.
Torquay.....	53·1	61·5	11·4	78	27·62	1726 †	A. Chandler.
Newquay	52·7	60·1	8·0	83	27·83	1642	Dr. A. Hardwick.
Falmouth	52·9	60·7	10·1	82	34·26	1894	W. L. Fox.
Scilly (St. Mary's) ..	53·3	60·6	9·5	84	27·06	1872	Dr. T. T. Macklin.
Guernsey	53·9	62·1	10·5	84	34·36	2091 †	A. Collenette.
Jersey (St. Aubin's)	53·5	62·3	11·1	82	30·31	2027	J. Fisher.
Manchester	51·0	60·2	10·8	80	29·82	1090	Dr. J. Niven.
London (Greenwich)	51·6	61·9	13·3	79	18·85	1415	The Astronomer Royal.

* No Observations.

† Jordan Recorder.

‡ Instrument acquired during the year.

§ First half-year, Jordan Recorder; second half-year, Campbell-Stokes Recorder.

|| Results not received at the time of going to press. ¶ Mean of daily Max. and Min.



R.W. MUNRO MAKER, LONDON.

PRESSURE TUBE ANEMOMETER RECORD AT Marshside, Southport. Jan. 12 to 13, 1899.

